

Editor's column

Deborah Frincke, PhD

It is my distinct privilege to introduce the 20th anniversary issue of *The Next Wave (TNW)*. The timing is striking for me personally because I finished my own PhD and began my first faculty job some 20 years ago. I, along with other newly minted PhDs that year, dreamed of technological changes in so many areas—faster computers, making the user experience safer and friendlier, embedding our beloved technical devices in our personal lives . . . the list goes on. Many of those dreams have been realized or exceeded, and you'll read about a few of them in this issue.

The world of 1993 believed 60 gigaflops^a was blazingly fast and thought individual users would never have access to such speeds—or the need to use them. And we could begin to point out relatively affordable systems. After all, a Beowulf cluster in 2000 brought the cost of a gigaflop down to \$1,300^b, quite remarkable given that in 1961 the estimated cost was over \$8 trillion and in 1984 was around \$33 million. Our world has gotten significantly faster since then; Lawrence Livermore National Laboratory's Sequoia supercomputer clocked in at 16.32 petaflops in June 2012, and Oak Ridge National Laboratory's Titan supercomputer achieved 17.59 petaflops just a few months later. Today it is possible to get a gigaflop for well under a dollar.^c

Also important from a scientific perspective is our new, broader approach to setting expectations in this space. While the LINPACK measurement of peak floating point performance has long been used as a way to compare supercomputers, newer approaches are gaining traction. One such example is the Green500 list, which ranks machines by energy efficiency. A personal favorite is the Graph 500 approach, which pulls us into graph-based algorithms and, by extension, shows us how efficiently our modern computers will perform when used for analytics rather than solving linear equations.

The 1990s not only saw the emergence of the World Wide Web, it ushered in a decade in which we saw many pragmatic improvements in user interfaces. Text-based interfaces, like

L-Gopher, gave way to Internet browsers Mosaic and Netscape. Fast forward to 2013, where we are pleased, though not entirely amazed, to learn that we can control our tiny smartphone screens through our gaze, where wall displays are reasonable choices for operational environments, and where tangible user interfaces (i.e., those allowing users to interact with their information through their physical environment) are part of our commodity gaming systems.

Nowadays we expect intuitive design and responsiveness, and we protest if the haptic screen on our pedometer-powered video games is not up to snuff. User experiences are less bound by the traditional keyboard and mouse and the one-size-fits-all constraints and are more apt to leverage increasingly subtle cues about how to tailor responses to an individual, whether through serving up interest-based advertisements or through periodically prompting a sedentary worker to get up and jog in the middle of the afternoon. Brain-controlled interfaces can also be found in games.

People are less users who interface with a specific computer than they are beneficiaries of a digital team, in which multiple devices and software are expected to work together smoothly to support the goals of the whole and even integrate with other digital teams to support social interaction. The ways to engage and the opportunities to improve are seemingly endless. Also, as we move into the next 20 years, it is worth pointing out that the challenges for those who seek to make user experiences safer and more secure are becoming harder, not easier—and it is even more important that we get this right.

There are always unexpected results when a society embraces a new concept and the commercial market races to meet the demand. As you'll see in the article "Radio noise: Global economic and political impact," our love of devices and the creative ways in which we use them has made the world of signals an extremely noisy, crowded, and messy place complicated by economic and policy conflicts. In 1993, my personal worries about radio noise involved wondering whether my new

a. CM-5, the number one supercomputer on the first TOP500 list, performed 59.7 on the LINPACK benchmark.

b. Amount is adjusted for 2012.

c. In 2012, an Advanced Micro Devices desktop with a quad-core processor sold for about 75¢ per gigaflop.

computer monitor would interfere with the neighbor's television set. (Sadly, it did, but the solution did not require nation-state summits—just moving furniture.) Modern conflicts over radio noise are much harder to resolve and have greater consequences.

The fourth idea explored in this special edition is single-photon detector technology. Here the future seems cloudiest. Will these technologies take off as spectacularly as wireless or as pervasively as the user interface? Will we see this turn into a widely used enabling technology, like high-performance computing? The authors from the Massachusetts Institute of Technology Lincoln Laboratory speculate about many possibilities. As with other technologies, the human wish to interact in new ways and in new environments is the real driver, and it seems safe to bet that if people need this technology, development could easily spike over the next 20 years.

One final thought: Whether the 40th anniversary issue of *TNW* touts a multi-zettaflop computer or introduces brain-controlled interfaces as old hat, the next 20 years are certain to be interesting ones. We'll still be weighing the needs of the many versus the one (e.g., radio noise), speculating about economic drivers that might accelerate innovation (e.g., single-photon detection), and redefining what makes one computer or interface better than another. Our technological dreams are an expression of our human selves, and we are complicated social beings who somehow seem to overcome theoretical limitations with new ways of thinking. Our technologies are the same way. Here's to the next 20 years—may they fill us with as much wonder as the last!

Della G Franke

Deputy Director

Research Directorate, NSA

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